uCLinux
for
Custom Mobile Devices

ELC 2013

*** PRELIMINARY ***
Final version available at http://www.hy-research.com/download

HY Research LLC
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Feb 11, 2013
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Agenda

* Introduction
* What kinds of Mobile Devices
* What is uCLinux
* uCLinux vs Full Linux
* uCLinux vs baremetal
* uCLinux limitations
* Min. hardware of a SoC
* Cost comparism

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Introduction

* Low volume:
  * under 1000/year
  * Not consumer
* Small form factor (2" x 2")
* Embedded/specific function
* Linux

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Mobile Device

* Low power (battery)
* Small size
* Not maxing CPU
* Why build?
  * Size may preclude modules
  * Connectors
  * Unavailable optins
  * Destiny!

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Mobile Device

\<Insert picture>

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What is uCLinux?

* For microcontrollers
* NOMMU linux
* Roots in the 68K
* Most code in mainline 2.6
* Ported to ARM Cortex-M3 (focus)

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uCLinux vs full Linux

* Smaller
* No memory protection
  * optional MPU support
* No VM (or demand loading)
  * Can do XIP
* Most Linux code can be recompiled:
  * No glibc, mmap(), fork(), sbrk()
* Uses FLT instead of ELF

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uCLinux vs bare metal

* Linux driver library
* Linux software stacks (BT, USB)
* No need for simulators
* Reuse/share code with full Linux
* Provides a path forward
* No new toolchain/process.

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uCLinux Limitations and Advantages

* Cheaper hardware prototyping
* Reuseable with full Linux
* Cortex-M shares Thumb instruction with Cortex-A
* Potential parts sharing (i.e.preprogrammed media with same filesystem)

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uCLinux Limitations and Advantages (con't)

* Requires external memory
* No MMU:
  * No null ptr check
  * No userland/kernel seperation
  * No VM

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Hardware in a SoC System

* SoC
  * Available in desired volume?
  * Provides IO?
* Memory
* Power
* Storage

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Sample comparism

Full Linux using TI's Sitara processor

* Cortex-A8
* I/O at 1.8V
* POP package for footprint
* Min. combo:
  * TPS65950
  * AM3703
  * RAM
  * Storage

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Sample comparism

Full Linux using TI's Sitara processor

* PCB requirements

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Sample comparism

Full Linux using TI's Sitara processor

* Part costs:
  - AM3703 - $27.50
  - TPS65950 - $10.45
  - POP memory ~$8.00
    MT29C4G48MAZAPAKQ-5
  - Charger block
  - PCB <INSERT PCB Price>

* Digikey single pricing as of Feb 7, 2013

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Sample comparism

uCLinux using ST's STM32 family

* Cortex-M3
* 2.0-3.6V IO
* Min combo:
  * STM32F103ZG
  * LDO
  * PSRAM

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Sample comparism

uCLinux using ST's STM32 family

* PCB requirements

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Sample comparism

uCLinux using ST's STM32 family

* Parts
  * STM32F103ZG - $14.63
  * PSRAM (8M) - $9.34
  * LDO - ~$2.00
  * Charger block

* Digikey prices Feb 7, 2013

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Sample comparism

uCLinux using ST's STM32 family

* Parts
  * STM32F103ZG - $14.63
  * PSRAM (8M) - $9.34
  * LDO - ~$2.00
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* Digikey prices Feb 7, 2013

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Conclusion

* uCLinux can do the essential of Linux
* uCLinux offers a path forward
* Prototyping costs can be lower with uCLinux HW
* Small devices may have to be custom built

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Links

* https://en.wikipedia.org/wiki/Picotux
* http://www.uclinux.org/
* http://opensrc.sec.samsung.com/
* http://www.linux-arm.org/LinuxKernelM3
* Documentation/nommu-mmap.txt

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Questions?

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